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INTERNAL-COMBUSTION ENGINE

Technical Background

The invention regards an internal-combustion engine according to the preamble of claim 1.

In known internal-combustion engines with rotary slide valves, e.g. according to DE 3943069 A, the rotary slide valve is provided in the form of a tube having a diagonal partition. Each of the two parts is provided with an opening situated at the same level on the cylinder surface of the rotary slide valve. The centers of the two openings, as well as the longitudinal axis of an engine cylinder, are situated on a shared axis, running perpendicular to the longitudinal axis of the rotary slide valve. The two openings are therefore situated in the area above a cylinder. The two chambers of the rotary slide valve temporarily connect one or several cylinders with an exhaust manifold and an intake manifold for fresh air or a fuel/vapor mixture.

This is however disadvantageous, since in these chambers significant turbulence and thus a corresponding increase in flow resistance can be observed. Thus, the filling or emptying of the cylinder might be delayed. Moreover, the volumes of the cool gases flowing into the cylinder and of the hot exhaust gases leaving the cylinder are very different, this fact not being taken into account if the chambers of the rotary slide valve are provided with the same profile.

An internal-combustion engine of the above-mentioned kind is known from DE 3132831 A. The rotary slide valve of that

document is designed in the form of a double-walled tube with two passages separated from each other, the cylindrical inner passage of which is provided for discharging the exhaust gases and the outer shell passage of which is provided for supplying air or a fuel/vapor mixture, the passages being provided with radial ports directly leading to openings at the outer shell surface of the rotary slide valve and connecting one or several cylinders, depending on the turning position, to intake or exhaust ports. Thus, it is possible to adapt the profiles for supplying air or a fuel/vapor mixture or the hot exhaust gases to the corresponding volumes in an easy manner. Moreover, thanks to the proposed measures, relatively big surfaces are provided, by means of which a heat exchange between the hot exhaust gases flowing out and the cool gases flowing in is made possible. Thus, the fresh air or the fuel/vapor mixture is adequately preheated.

One problem of rotary slide valves concerns their sealing. According to DE 3132831 A the seal is pressurized from below, which requires, however, comparatively large technical efforts. Furthermore, this measure is inconvenient since it causes an even stronger deflection of the rotary slide valve than that already caused by the engine pressure.

Disclosure of the invention

Technical Problem

It is the object of the present invention to provide a seal which requires less technical effort; furthermore, the deflection of the rotary slide valve should be avoided, if possible.

Technical solution

This object is attained according to the invention by an internal-combustion engine of the above-described kind by providing a pressure plate abutting the rotary slide valve on the side of the chamber facing a passage of a cylinder and moveably mounted in a cylindrical chamber of the cylinder head, the end of the cylindrical chamber that is turned away from the rotary slide valve being connected by means of a pressure passage running through the cylinder head to the area adjacent to the cylinder opposing the pressure plate.

According to the invention, engine pressure is used to load the pressure plates. Thus, the technical effort is considerably smaller than in the known solution. Moreover, the pressure plate acts from the side opposing the cylinder. Thus, a unilateral action of the high forces developed during the compression and power strokes of a cylinder of the internal-combustion engine on the rotary slide valve is advantageously avoided; instead, they act from two opposed sides. Thus, a reliable sealing of the rotary slide valve against its seat in the cylinder head can be achieved and the deflection of the rotary slide valve is small.

Preferably the pressure passage is filled with a fluid, e.g. oil, and a membrane is provided at the side of the cylinder in the entrance of the pressure passage. Thus, an improved transmission of power onto the pressure plate is guaranteed.

It is convenient to provide a rotary slide valve which can be intermittently driven, preferably by means of a Geneva

movement, so that the turning positions of a radial port also directed at a cylinder opening can be maintained with full cross section for preselectable time intervals. This results in the position of the rotary slide valve remaining unmodified for a predefined time interval, e.g. a position in which an opening of the shell surface of the rotary slide valve aligns with an opening of the cylinder concerned, by which the full profile of these openings is exposed during this time interval and a correspondingly rapid gas exchange can take place.

It is advantageous to provide at least the inner passage in the form of a ceramic tube in order to ensure a long service life of the rotary slide valve. Thus it is ensured that the wall of the inner passage can resist the corrosive exhaust gases.

Finally, for cost-efficient production it is advantageous to provide the cylinder head in two parts, the chamber for the reception of the rotary slide valve being formed by depressions having semicircular profiles.

Short Description of the Drawings

One embodiment of the object of the invention is shown in the enclosed drawings. Therein:

FIG. 1 is a longitudinal section through a rotary slide valve held in a cylinder head according to the invention along the line I-I of FIG. 2;

FIG. 2 is a section along the line II-II of FIG. 1;

FIG. 3 is a section along the line III-III of FIG. 2;

FIG. 4 is a longitudinal section through a rotary slide valve;

FIG. 5 is a section through the rotary slide valve along the line V-V of FIG. 4;

FIG. 6 is a section through the rotary slide valve along the line VI-VI of FIG. 4; and

FIG. 7 is a section through the rotary slide valve along the line VII-VII in FIG. 4.

Best modes for using the invention

According to FIG. 2, the cylinder head 13 comprises an upper cylinder head part 2 and a lower cylinder head part 3. A rotary slide valve, generally indicated with 1, is rotatably mounted in a chamber 30 of the two cylinder head parts 2 and 3 - as can be seen in FIG. 1. The axis of the rotary slide valve 1 runs on the separation plane 31 of the cylinder head parts 2 and 3.

An exhaust gas manifold 11 is mounted coaxial to the rotary slide valve 1 is flanged on at a front end of the cylinder head 13. The front side of the rotary slide valve 1 is sealed by means of a seal 7, 14.

At the other end of the rotary slide valve 1, it is connected to an axle stub 32 such that it cannot be moved, the axle stub 32 passing through a cover plate 9 of the cylinder head 13. On the free front side of the axle stub 32, a control wheel 3 is mounted such that it cannot be turned. The rotary slide valve 1, prestressed against the exhaust gas manifold 11 by means of a spring 8, is sealed by means of radial shaft seals 12 set in both sides in both cylinder head parts 2 and 3, in order to avoid leakage of lubricant.

Within the area of two cylinders 33 and 34 incorporated in a cylinder block 35 which may e.g. be part of a flat four, the cylinder head part 3 has ports 36 coaxially mounted to cylinders 33 and 34, of which one is associated to each of the cylinders 33 and 34. The ports 36 end in the chamber 30 holding the rotary slide valve 1.

The cylindrical rotary slide valve 1 in the form of a double-walled tube has an inner cylindrical passage 40, preferably formed by a ceramic tube and provided for discharging exhaust gases. The central passage 40 is connected with two radial passages 41 and 42 in the illustrated embodiment (FIG. 5 and FIG. 6) offset by an angle of 90°, end at the shell surface of the rotary slide valve 1 and - as can be seen in FIG. 1 - are aligned with the ports 36 of the cylinder head part 3. The rotary slide valve 1 is sealed at edges of the ports 36 by means of seals 37.

As can be seen in FIG. 1, an intake port 10 opens perpendicularly into the cylinder head part 2 between the flanged-on exhaust gas manifold 11 and the radial shaft seal 12 adjacent thereto, provided for supplying fresh air or a fuel/vapor mixture. The rotary slide valve 1 disposes of four radial ports 38 (FIG. 7) on the level which is perpendicular to its axis and comprises the intake port 10, a ring chamber 39 being incorporated in the two cylinder head parts 2 and 3, on the level of these radial ports 38, so that fresh gas flowing through the intake port can flow in a shell passage 44 of the rotary slide valve 1 through the ring chamber 39 and the radial ports 38. These radial ports 38 are

evenly spaced over the circumference of the rotary slide valve 1 (FIG. 7).

This shell passage 44 through which fresh gas, e.g. fresh air (if an injected engine is concerned) or a fuel/vapor mixture (if a carbureted engine is concerned) flows in the direction of arrow 43, is connected to the shell surface of the rotary slide valve 1 through further radial ports 45 and 46. These radial ports 45 and 46 leading away from the shell passage 44 lie on on a plane perpendicular to the axis of the rotary slide valve, on which also the radial passages 41 or 42 of the central passage 40 are oriented (FIGS. 5 and 6) and on which also the axes of the cylinders 33 and 34 are situated.

As can be seen in FIG. 2, the cylinder head part 3 has recesses at the ports 36 on the side facing the cylinders 33 and 34, which are provided coaxially to the ports 36. From these cutouts 5 a pressure passage 20 which is sealingly closed at the outer side of the cylinder head parts 3 with a stub 16 branches transversely off to the upside. This transverse pressure passage 16 passes into a divided pressure passage 17 running in the direction of the axis of the cylinders 33 and 34, extending into both cylinder head parts 2 and 3. On the separation plane 31 of the cylinder head 13, that is between the two cylinder head parts 2 and 3 a seal 18 is provided surrounding the pressure passage 17. The pressure passage 17 passes into a pressure passage 15 transversely leading upward in the cylinder head part 2 and being sealed toward the outside by a stub 16 and leading to a cylindrical chamber 50. In the chamber 50, a pressure plate 6 is moveably

mounted in the direction of the axis of the cylinder 33 and 34 coordinated to the chamber 50 and sealed against the cylindrical chamber 50.

The pressure in the cylinder 33 and 34 is transmitted to the front surface of the pressure plate 6 turned away from the rotary slide valve 1 through the pressure passages 20, 17, 15, which results in the pressure plate 6 being pressed on the rotary slide valve 1 with a force corresponding to the pressure in the cylinder 33 and 34 and avoiding on the one hand deflection of same, due to the pressure within the cylinder 33 and 34 and on the other hand contributing to a tight sealing of the rotary slide valve 1. Thus, pressure loss in the cylinders 33 and 34 is avoided.

For improved force transmission in the pressure passages 20, 17, 15 and in the chamber 50, these can be filled with a fluid, such as for example oil. Thus, it is necessary to provide a membrane on the side of the cylinder at the entrance of the pressure passage 20.

According to FIG. 3 for each cylinder 33 and 34, seats are provided in the cylinder head parts 2 and 3 for an injection nozzle 21 and a spark plug 22. Moreover, the cylinder head parts 2 and 3 are penetrated by cooling passages 19 (see FIG. 2) provided for conducting cooling water.

In known manner, an unillustrated crank shaft interacts with unillustrated connection rods and with unillustrated pistons which can be axially shifted in the cylinders 33 and 34. During operation, a fixed rotational relation between the crankshaft and a drag wheel (unillustrated) acting on the control wheel 4 (which

might be part of a Geneva movement) is provided. The drag wheel can be driven by a synchronous belt drive between the crankshaft and the drag wheel. The rotational relation between the crankshaft and the control wheel 4 is a 2:1 reduction.

In the position of the rotary slide valve 1 shown in FIG. 1, the cylinder is in the exhaust cycle, the cylinder 33 being connected via the port 36 of the cylinder head part 3 and the radial passage 41 with the central passage 40 of the rotary slide valve 1 and thus with the exhaust gas manifold 11.

Simultaneously, the cylinder 34 is in the intake cycle, the cylinder 34 being connected to the shell passage 44 over the port 36 and the radial passage 46 and the shell passage 44 is connected to the intake port 10 over the ports 38 and the ring chamber 39, so that fresh air can flow into the cylinder 34.

The heat exchange between the hot exhaust gases flowing through the central passage 40 and the fresh air flowing through the shell passage 44 in the opposite direction takes place during this process.

During the two remaining cycles of a four-cycle process, the ports 36 of the cylinder head part 3 are closed by the rotary slide valve 1, as can be seen in FIG. 5 and FIG. 6.

The turning movement of the rotary slide valve 1 is intermittent if a Geneva movement is used, such that the ports 36 of the cylinder head remain fully open for a predetermined time interval of a turn of the rotary slide valve 1, by which a rapid gas exchange in the cylinders 33 and 34 is ensured.

The motor described here can also be used for transforming compressed air into mechanical energy. If mechanical energy is available, the motor may be used as a compressor or as a vacuum device.